

MATURING FROM CBT TO WBT IN AN ADL AND SCORM ENVIRONMENT

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Abstract

How do we overcome the instructional and technological challenges of implementing ADL and SCORM in large, disparate organizations such as the Air Force and DoD? Our traditional education and training environment involves a wide variety of resident, paper-based, and CD-ROM courses. Advanced Distributed Learning (ADL) and the Sharable Content Object Reference Model (SCORM) standard provide an admirable goal and vision for a new Internet-based instructional approach--what steps must the Air Force and DoD take to reach such a destination? What paradigm shifts are necessary and what are the critical tasks in deploying a Learning Management System (LMS)? How do we make best use of the information technology (IT) infrastructure when it may not be fully ready to support ADL? How do we design instructional systems and content for effective reuse? AFIADL has participated in many projects, initiatives, pilots, and prototypes that have generated the practical experience needed to answer these key questions. Specifically, our paper focuses on ADL lessons learned, conclusions, and recommendations.

Biographical Sketch:

Duane Hellums is Chief, Instructional Technology Applications Branch, at the Air Force Institute for Advanced Distributed Learning. He primarily works enterprise-level ADL architecture and learning management system issues. Duane is an experienced project manager, a published author, has 25 years foreign language experience (Russian and Spanish), and is an Adjunct Faculty member of the National Cryptologic School, where he is certified to teach several intermediate Russian language courses. As an early proponent of distance and advanced distributed learning (ADL) technology, he engineered an electronic bulletin board system in 1994 to support interactive foreign language training and discussion groups for linguists in the Pacific Rim. Duane has a Master of Science in Information Systems and a Bachelor of Arts in Management Studies.

INTRODUCTION

The Air Force Institute for Advanced Distributed Learning (AFIADL) is the focal point for ADL in the Air Force. In this capacity, we have led or participated in numerous service-specific and joint ADL initiatives and projects. Through these endeavors, we've learned many valuable lessons that we'd like to share about implementation of ADL in a distributed enterprise environment.

This paper obviously is not meant to be a rundown of all ADL initiatives and projects currently underway in the Air Force. While it aims to be comprehensive, it should not be considered exhaustive or all-inclusive in any respect. As the title suggests, this is merely a snapshot of our current state of experience. The Air Force and AFIADL are working hard to define mission and system requirements in this rapidly evolving ADL environment, as we attempt to adapt or extend our current information technology infrastructure to support it.

LEARNING MANAGEMENT SYSTEMS (LMS)

An LMS is often the linchpin of an organization's ADL efforts, despite the fact that what constitutes an LMS is open to debate. Without a centralized approach, online learning and instruction could become a somewhat fragmented, disorganized conglomeration of uncoordinated activities. The first challenge most people encounter when considering the purchase of an LMS is defining what an LMS actually is. Unfortunately, there are almost as many definitions as there are vendors. Suffice it to say that an LMS should be considered nothing more than a suite or collection of shared applications, databases, services and electronic capabilities or features—cumulatively, this suite of tools directly enables, enhances, promotes, or supports ADL and online learner support.

You may also see the term Learning Content Management System, or LCMS, which usually involves an integrated development tool that stores learning content and metadata in a searchable database as small, reusable “chunks.” Avoid the trap of believing that an LMS or LCMS is merely a simple software application that you can buy, install, and configure to immediately meet all your ADL needs—there is no “silver bullet” for ADL. Each LMS vendor has a different opinion of what capabilities an LMS should have, so it's unlikely you'll find one that satisfies all your requirements “out of the box.” As a result, you have several acquisition options available to you.

Commercial Off-The-Shelf (COTS)

The term COTS typically is used to describe commercially available software that is built for a wide variety and number of customers. Due to its relative low cost, COTS acquisition currently is the preferred means of building out information systems within the Department of Defense, where it is feasible. The competing approach would be for an individual organization to develop its own custom system, which may or may not be shared with others. Government owned software that is shared with others is known as Government Off-The-Shelf, or GOTS, which is also a good option to pursue, if it's available. Many people prefer a COTS solution because it could avoid a large system development project that has a high implementation and lifecycle support cost. Unfortunately, few people will find a COTS LMS that does exactly what they need it to do. This could result in a considerable amount of system customization. Additionally, many people don't know exactly what they need from an LMS—they just know they need an initial operating capability to deliver and manage online courses and students.

Minimal COTS. If your requirements are well defined, and you've analyzed the market well, you may decide that developing your own LMS is the only suitable solution. You may even incorporate certain COTS components in your system. Over time, supporting such a system can be very costly, so a good amount of thought and planning should occur before implementing such a solution. This is a suitable option if you have properly determined and validated all your requirements and find that this is the only method of providing the functionality you critically need. It is not a suitable option if your funds and resources are significantly restricted.

Shrink-Wrapped or Customized COTS. If you're lucky, you will find a COTS application, or a combination of COTS products, that meets most of your needs. This is especially true if you're only looking for an 80% solution and can work around a few requirements not being satisfied. If you must customize COTS software, pay special attention to the many configuration management, integration, and testing issues that will arise. COTS vendors build software around an existing “baseline,” which is usually the previous commercial version or release of the product. As a result, you may experience significant problems upgrading to their new version if you install it on top of your “custom” version of their product. You may find that some of your custom changes no longer work, or some of their new features malfunction. You should coordinate closely with the vendor to avoid making

low-level changes that have a high probability of creating future conflicts of this kind, if possible. This may not be an issue if you buy a product outright and never plan on upgrading. However, you also would miss out on the new features, such as compliance with new and evolving standards that the COTS vendor is rolling into their product line.

Application Service Provider Hosting. One option you have is to host your courses with an online application service provider, or ASP. In certain ADL environments, this can be a good solution. Basically, the cost of implementing an enterprise ADL capability is borne by the ASP, and shared across all of the resulting system's users. When changes are made to the system, all subscribers to it benefit by default. This may mean that you get new capabilities that you didn't want or need, but at a fraction of the cost of building out your own system. A key detractor from using such a solution, especially in the military environment, is the security issue. ASP handling and protection of student data and Privacy Act information may not be secure enough to satisfy military requirements. The ".com" servers also may not be allowed to interface with existing record systems inside the .mil domain.

Key LMS Considerations

There are no magic bullets or secret recipes for acquiring a learning management system or its components. Many people have found that LMS "checklists" are not very useful in evaluating products or in identifying requirements. Each ADL environment is significantly different, and this paper does not aim to be the definitive guide on choosing an LMS. However, there are a few basic things systems engineers and program managers typically look at when evaluating a product. Considering these questions might help you refine your requirements and better analyze the current market offerings against your requirements. First and foremost, try to get temporary access to the LMS you're interested in and develop or integrate a small sampling of learning content or courses, *before* you make a decision to buy—you may find that the LMS isn't as great as it looks in marketing material.

COTS Functionality. Some organizations merely need an LMS for delivery and management of online courseware, while others want to manage in-residence instructions, or a hybrid of the two approaches. What do you need from the LMS? From both an instructional and technological standpoint, which features are most important and which are just nice to have? Will COTS or GOTS satisfy your critical requirements, or will you need to develop your own system? Do you need the LMS to support synchronous chat? Do you have legacy

content and courseware in proprietary formats that the LMS must support? Do you need the LMS to interface with enterprise database or personnel systems? Does the LMS support the necessary level of granularity designed into your content and courseware? Does it support the Web-based formats that your development tools generate? Does it fit in well with your instructional system design (ISD) process? As a starting point, try coming up with a "Top 10" list of things you absolutely need an LMS to do, preferably with concrete examples.

Lifecycle Support Cost. Unless you are building a pilot or prototype, you will have to maintain your LMS over a long period of time. Can you afford to keep and continue operating the system you plan to purchase or develop? In addition to the initial procurement cost, what are the annual upgrade and maintenance charges? Are there recurring license fees, per end user or per course? What will it take to customize the LMS and maintain those changes over the next 5-10 years? Does the development model for the LMS require you to insert proprietary code in each course, lesson, module, or page? Removing this data when you move the course, or attempt to reuse or share it, may prove very expensive. What are the hidden or discovered costs you will have to bear? Make sure you read the small print of LMS licenses and support contracts, before you buy. You may also find that some costs are negotiable.

Ease of Use. Some computer-based products are much harder to use than others, which makes them less applicable to certain operational environments—if the system is too hard or cumbersome to use, people will either not use it or seek easier methods of getting the job done. Are the LMS tools user-friendly? How long is the learning process? Does the vendor provide paper-based and online tutorials on how to use, administer, and develop courseware for the system? Does the LMS facilitate and enhance online instruction, or complicate and frustrate it?

Scalability. Most people want to buy a system that will not only meet their needs today, but also "scale up" to satisfy their expected future requirements. As the system grows and serves larger audiences with more courses, will the system still function properly? What is the largest implementation the LMS vendor currently supports in the field? Is there a maximum number of courses, students, administrators, records, or discussion groups that the LMS supports? Does it support a distributed architecture that allows databases, applications, services, and data to all be hosted on separate machines, if necessary?

Interoperability. An LMS generally exists in a network environment involving many other systems, architectures, and interfaces—the degree to which the LMS gets along well with the network can be more important than the amount of functionality it provides. Does the LMS have built-in support for connecting to other enterprise database systems that contain personnel and student records, authentication data, or learning objects? Does it support integration with all industry standard relational database products, or just one? Do the LMS tools and utilities effectively work across the network, at the available bandwidth and through all the networking hardware?

Legacy Content Support. Many organizations have a plethora of effective and costly learning content and courseware developed for compact disk (CD) or the Web browser, but not directly for integration with an LMS. How successful has the LMS vendor proven to be in supporting the import or integration of existing legacy content? Since it's not economically feasible to repurpose all legacy material, does the LMS support management of computer-based training (CBT) formats on CD, as well as the default online delivery models?

Standards Support. Adherence to standards within the online learning community is critical for promoting interoperability, reuse, and repurposing of learning objects in an ADL environment. How well does the LMS vendor support these existing and evolving standards? To what level do the LMS, its tools, and its underlying database conform to the Sharable Content Object Reference Model, or SCORM? If you don't currently have SCORM-conformant courseware, will the LMS be ready for such content when you want or need to deploy it? What other learning industry standards does the LMS support and adhere to?

Security. Network security, with good reason, is probably the biggest deterrent to implementing an enterprise ADL architecture or LMS solution. To ensure network security, firewalls prohibit certain ports and protocols, and network security personnel sometimes do not allow software, including multimedia plug-ins or players, to be installed on client PCs. Does the LMS function properly across your local area and wide area networks, including through all the applicable firewalls, proxies, and network application filters? Does it require the learner, administrator, developer, or designer to install specialized application software or browser "plug-ins?" If your LMS provides e-mail or discussion group functionality, will the security team allow you to install these additional services, or interface with existing e-mail servers?

Reuse and Repurposing. Most organizations will want to make use of existing learning objects and courseware, which will require it to be imported or integrated with the LMS. Even with SCORM and similar standards, the Web has proven to be a difficult environment to promote easy migration of content from one browser and Web application environment to another, without some modification. Instructional systems designers today do not have as much control over the learner's runtime environment, through a Web browser, as they had with traditional CBT or CD courseware, which executed at the operating system level. How efficient is the process of pulling this type of content into the LMS? Is it a seamless process, or is it relatively painful, requiring large portions of the content to be handled again, modified, and tested? Consider asking the LMS vendor to demonstrate this functionality with real-world courses, rather than just accepting assurances that it can happen.

Recommendations

Don't pass up an opportunity to ask people about their past LMS experiences and lessons learned. Generally speaking, project managers implementing an LMS or other type of ADL solution will encounter many similar problems as their colleagues that have gone before them. AFIADL routinely tracks "lessons learned" provided by other organizations in the ADL community, and seeks to share our own lessons learned with others. Avoiding known problems and following proven models and techniques can help everyone in the ADL community develop a more effective, efficient, and affordable ADL architecture.

Requirements. They say the three most important things in real estate business are location, location, and location. In the systems world, and especially in enterprise ADL and LMS acquisition, the three most critical probably are requirements, requirements, and requirements. If you don't know what you need, you increase the chances of building out something that doesn't satisfy your needs. Most people know a few of their requirements, but not all of them. Others base their requirements on existing models, such as in-residence training, without considering feasibility and cost in an ADL environment. Through the use of phased implementation, as well as prototypes and pilots, you greatly increase your chance of success.

Prototypes and Pilots. If requirements are unclear, the most appropriate and successful approach is generally to build out a prototype or pilot implementation of a system. This allows you to start out slow, reduce risk, not commit too many resources in a direction you later have to abandon, and incrementally analyze, define, and

document your requirements as you go. This is also known as spiral development and evolutionary acquisition, and is a method AFIADL has successfully adhered to and recommended for its many partners and collaborators.

A detractor to such an approach is that some people may consider this a mere failure to commit to a specific product, solution, or system. These people may fail to see the power of it, and may not appreciate the lack of well defined and agreed upon requirements. Another potential pitfall is that managers may attempt to leverage the initial operating capability, and seek to elevate the pilot or prototype directly into an operational system. This may not be the most appropriate answer given the new requirements that are incrementally becoming known. Project managers should resist this temptation—stress the need to consider the pilot a sunken cost or "throw away" capability throughout the initial project phases. Once the requirements are fully documented, you can evaluate the pilot/prototype on its own merit against other potential solutions that are appropriate at the time.

Unexpected Requirements. While you obviously can't plan for the unknown, keep a sharp eye out for "hidden" requirements. Anything that could possibly impact your LMS or ADL project should be promptly analyzed and handled as soon as possible. Ignoring a lurking requirement and potential problem generally only makes it worse, over time.

Examples of some common constraints include SCORM-conformance, compliance with Section 508 and Americans with Disabilities Act, compliance with the Defense Information Infrastructure Common Operating Environment (DII-COE) or Joint Technical Architecture (JTA). There are also many security considerations, such as need for a certification and accreditation (C&A) package, Permission to Test (PTT), Certificate of Networthiness (CON), Certificate to Operate (CTO), and a Command, Control, Communications, Computers and Intelligence Support Plan (C4ISP). There also may be a host of memorandums, policies, directives, instructions, and guidelines that you must adhere to and take into account. Each project is different, based on the particular environment involved.

Sufficient Planning. A good balance of planning and execution is required for project success. The tendency is for project managers to rush through the planning stage and skip into the design and implementation phase too early. Mileage will vary, but you should consider a healthy portion of upfront analysis, along the lines of 25-30% planning and 70-75% execution. The

more questions you can answer up front, the better off you'll be later. If you only spend 5-10% of your time planning and then proceed to execution or implementation, you will probably find that over time that you regress into earlier stages as a matter of necessity. In the long run, this greatly extends the project completion date, and significantly increases the amount of work and resources required. Most importantly, you should plan system interfaces as early as possible, since they are typically the most complicated, risky and costly aspects of any system project.

Configuration Control. Very early in your project, you should plan how you will handle change requests and problem reports for your enterprise LMS or ADL system. Everyone using a centralized system will want a different look and feel, or a separate set of functionality that is peculiar to a particular situation. Without an effective and agreed upon change management process, you may negatively impact the group, or find yourself expending a lot of resources making small and insignificant changes, or correcting previous changes. Due to the complexities of such an enterprise system, planners should follow time tested system processes for maintaining software and hardware. This is especially true if your LMS involves COTS software maintained and updated by a vendor while you are simultaneously making changes to your system locally.

Rework. There is a common misconception that learning objects, content, or courseware designed to an individual learning standard, such as SCORM, will guarantee seamless migration of courseware from one LMS to another. Unfortunately, many standards are not mature enough to ensure this type of "plug and play" capability. It helps to know what LMS you will be using, and design content for that particular environment. However, designers and developers should still try to create content that can be used across these artificial LMS boundaries, to the extent possible. Resources permitting, content should be tested in multiple LMS environments to identify potential reuse and repurposing problems that need to be resolved. Content creators should also resist the temptation to use proprietary features of an LMS within content, since this limits its reuse potential. If at all possible, this type of functionality should be built directly into the content in such a way that it promotes integration with other LMS environments.

SECURITY

As mentioned previously, network security by its very nature creates some roadblocks to creating an effective

ADL environment. Luckily, security measures protect us from unauthorized users and malicious logic that would expose or corrupt our data, or otherwise deny use of the network resources. However, attempting to prevent unauthorized uses sometimes prevents authorized users from conducting approved activity on the network. Obviously, it would be unacceptable to loosen industry standard security measures just to promote use of certain ADL technologies. This makes it difficult to find the right combination of available, but safe, technologies and tools that enable ADL without exposing us to unnecessary threats.

Firewalls

Firewalls are usually the first line of defense against users with malicious intent. A firewall can be either hardware or software, and basically serve the purpose of being a network "traffic cop," determining what bits of information are allowed in and out. Certain technologies are prohibited outright because they are too insecure and have known exploits that hackers use. Firewalls are broadly used across the commercial and public Internet, as well as within the military. While enterprises normally specify a standard configuration for these firewalls, individual organizations or locations may stray from the standard to provide additional levels of security for more critical mission areas. This can make troubleshooting of network access problems rather difficult. Just because certain technologies can't make it past the firewall, they aren't necessarily insecure or dangerous. For example, Shockwave and Flash are sometimes inadvertently prohibited as a result of a network firewall configuration that is actually targeting other technologies—the impact on Flash and Shockwave traffic is merely incidental.

Along similar lines as firewalls, there are a few other security technologies that come into play in an ADL environment. These include proxies and filters. Proxies are used to "mask" or hide network addresses of individual computers and network devices. While most technologies work seamlessly with proxies, there are some that misbehave and don't operate as advertised. This can often be corrected by configuring the Internet browser to bypass the proxy, although some users don't have the necessary permissions to accomplish this. Filters are used by certain applications, such as email or even proxies, to prohibit certain content or Internet addresses. This can be a positive tool, because it prevents navigation to unofficial or unauthorized sites. However, the business rules created by individual organizations may have unintended consequences. For example, some network administrators prohibit access to commercial Web-based email providers, since they generally already

provide access to enterprise email programs and message storage. Unfortunately, a certain LMS or ADL program may have an email component built in, even though the learner, developer, or administrator may not be able to access it.

If you can't get certain technologies to work on your network, especially the wide area network, and believe they are security related, there are options you can pursue. Firstly, work with the vendor to determine what technologies they are using that could be problematic from a security standpoint. Odds are they are aware of the problem from working with one of their other corporate customers that tried unsuccessfully to implement the default configuration. They may be able to help you configure their product to use alternative methods that are interoperable with your network. Secondly, you can approach the network security office to troubleshoot the exact problem and seek an enterprise solution, if possible.

Problematic Technologies

While most technologies today are network-based, not all of them have proven easy to deploy in a secure networking environment required of corporations and the military. This doesn't mean they shouldn't be considered, but only that they require special care and planning to use effectively across a wide area network—some of these technologies work fine at the local area or campus network level, such as on a military base or within a building. When purchasing an LMS or other ADL design, development, or administration tool, be sure to press the vendor or contractor for detailed information about these types of technologies. To be absolutely safe, you also might want to consider stressing the network security constraints as part of the official written acquisition process, such as in statements of work and task orders. Testing Web-based technologies directly on your operational network infrastructure is the best way to find problems as early as possible (preferably before you buy).

Client/Server Development Tools. Vendors often demonstrate their product in an "offline" mode on a single laptop PC or within a small conference room or classroom. While their product may work perfectly in such an environment, there is little guarantee it will work in other network scenarios. The best way to operationally test these technologies is on one of your own machines, over the physical network, through all its applicable firewalls, proxies, and filters, to a remote server, if applicable. Project managers should stress this critical requirement with visiting salespersons and technicians. Otherwise, you may buy something you

can't actually install or use. Network security personnel probably won't "poke holes" through the firewall just because you purchased a tool that needs a less stringent security environment. Even if you get the local network office to approve operation of such a tool, there is little guarantee other locations will have the same configuration, or that you can get the entire enterprise to buy off on weaker security, even if it's for enhanced capabilities.

Mobile Code. Department of Defense (DoD) currently provides clear policy and guidance on certain types of Internet technologies that, due to their inherent security weaknesses and known "exploits," are potentially dangerous to military operations. Mobile code includes any programming language or technology that downloads into your browser and executes or runs there without your permission. These Internet "scripting" technologies, such as ActiveX, Java, VBScript, and JavaScript, provide a high level of interactivity, but can be used by unauthorized users to steal network passwords, or by malicious users to spread viruses, worms, and other malicious logic.

There are some complicated rules for configuring browsers to prevent mobile code, as well as other rules for how developers should create objects using these technologies. For example, downloaded ActiveX components can only be executed if they are "signed" using DoD Public Key Infrastructure (PKI) signatures. On the other hand, Java applets must *not* be signed. Unfortunately, a DoD code-signing capability does not exist yet. In the meantime, browsers must be configured to prevent use of downloaded ActiveX, except under certain restricted circumstances.

You should become familiar with the current state of DoD mobile code restrictions and configuration guidance, since these could significantly impact implementation of an LMS, its tools, or your courseware in an ADL environment. As a general rule for the near-term, AFIADL recommends avoiding the more problematic mobile code technologies, if at all possible. This includes custom, downloaded ActiveX components—not ActiveX included with the operating system or browser—as well as Java applets. This will increase the probability of your ADL systems and content being accessible by learners and administrators.

Social Processing and Synchronous Collaboration Tools. Many people expect an ADL environment to support the ability for learners, instructors, and subject matter experts to be able to communicate in near real-time, or synchronously. Additionally, many expect an online means for course managers, designers, developers, support personnel, and administrators to

collaborate and communicate online, such as within an LMS. In addition to the common "chat" feature, frequently desired capabilities include whiteboards and file or application sharing. There are even Department of Defense standards for certain tools of this type, if they can be implemented successfully at the network level. Unfortunately, firewalls often prohibit use of the specialized ports and protocols that these tools need. Some products even require client/server software or mobile code, either of which might be restricted for a good portion of your customer base. Generally speaking, asynchronous communication is not a major problem, through the use of email and discussion groups or bulletin boards. However, you shouldn't assume that your customers all have access to their own email client or account, since they may be using someone else's PC or a shared PC, which they can't configure for their own use. A safer approach is to use server-side technologies such as a Simple Mail Transport Protocol (SMTP) gateway, or Web-based email forms and processors—this way your customers can use the services you provide directly from a standard Web browser. You could reserve use of email clients for advanced functionality and requirements, such as file attachments, receipts, or digital signing.

Streaming Media. Any robust ADL infrastructure will include a good degree of interactivity and multimedia support. Where it's instructionally appropriate and effective to do so, the ability to add audio and video to learning content can be a critical requirement. While it's not technically impossible, it can be relatively challenging to accomplish and support at an enterprise level. There are two main problems that most people encounter, including quality and security.

The trend on the Internet has been to migrate from "download and play" formats for audio and video to the use of streaming technology. Streaming allows people to download multimedia in smaller chunks and view it as it is downloading, rather than waiting a long period of time for the entire file to download. To keep the learner engaged and interested, it's generally accepted that online learning content should not have long pauses or breaks that could be distracting. This makes streaming a potentially useful technology for ADL.

However, the tradeoffs are reduced quality and possibly a larger number of enforced pauses caused by network "buffering." Buffering involves a small break in network activity while the software downloads the next few seconds of audio or video for the learner to hear or view—it can cause relatively choppy and intermittent performance. To keep streaming audio and video small enough to support quick downloads and near real-time performance, some shortcuts were taken to compress

the original multimedia source files. As a result, the quality of the "streamed" content can be significantly less than the original file. In certain scenarios, such as accredited courseware that is used for certification, it may be necessary to use higher quality "download and play" formats, even if they involve a longer download time. However, you should be careful to keep non-streaming file sizes small enough that the learner doesn't experience long download times. Connection speeds will drive file sizes, but you can expect most modem users to wait 2-3 minutes to download about 400 kilobytes of information. This could significantly impact the learning experience if there are lots of large downloads delivered back-to-back.

For those projects wishing to implement streaming media, the task can be difficult, but not impossible. Most importantly, it should be stressed that just because streams don't work in one environment or for one format or server, it doesn't mean streaming is impossible or prohibited across the entire network. Unfortunately, early implementers of streaming server technology used some networking protocol "shortcuts" to achieve better performance for audio and video over reduced bandwidth. These protocols turned out to be insecure, and thus were blocked by the firewall. Newer versions of these servers, and their associated clients, support the strict use of allowed ports (80, 443) and protocols (hypertext transmission protocol, or HTTP).

If you can control the streaming media server and configure it properly for network-friendly use, you will encounter less technical problems. Alternatively, you can host your content on servers that are properly configured. You can also save yourself quite a bit of trouble and learner support if you use streaming media formats that are supported by client software that comes bundled with industry standard operating systems and browsers—downloading and installing a plug-in can range from problematic to impossible for certain learners, depending on the level of control an organization has over individual computers.

ADL INFRASTRUCTURE

To be truly "anywhere, anytime," ADL requires a very strong technological base, especially at the network and personal computer (PC) level. Implementing ADL without an existing infrastructure can be extremely challenging, and requires a higher level of end user and learner support.

Network

ADL requires an extensive and robust network infrastructure. The larger the enterprise's network is,

the more problems that are likely to occur. However, if an enterprise has a single organization that sets policy and has strongly centralized control and management of the network, resolution of any ADL-specific problems can be greatly enhanced. Use of advanced technology and high bandwidth multimedia can stress the ability of a network to support ADL requirements. If not planned and conducted properly, it could also have a negative impact on the network's command and control or other assigned military missions. Advanced capabilities, such as multicasting, could greatly reduce the network bandwidth usage and better support ADL requirements. However, the need for a multicast-capable infrastructure across the Air Force complicates such a solution. For the time being, certain desired capabilities will have to wait for the networking infrastructure to support them.

Central Servers

Maintenance and support of the LMS or ADL system requires a full range of system administration and database administration services, which can often be contracted out. Course managers and instructional system designers and developers need access to an LMS, associated database and Web servers, and a broad range of information technology tools. Most organizations will also want a part-time or full-time help desk available to support ADL-related calls. The LMS or ADL system should be accessible from home (.com and .net domains) as well as from military locations (.mil, .gov domains). This can be extremely challenging given the military's need for protecting the integrity of the overall network. Often a single server can end up being the weakest link in the chain. Servers must also be able to interface with existing student record systems, if course completion data needs to be recorded to legacy databases. Where possible, an ADL system should support distribution of services across multiple servers. Such a solution is much more scalable, since email, Web pages, chat and discussion groups, streaming media, and databases can all be served from individual machines.

Learner's Work PC

As mentioned previously, designers and developers no longer have as much control over what happens on the learner's PC as they did in the age of CBT. Some learners may be using an operating system or browser that you don't expect, or have a much older PC without multimedia capability and very little processor speed and storage capacity. Other learners may be located in a building that gets very poor network performance and data transfer rates, which could impact the quality of

your instructional content and disrupt the learning process.

Network administrators or firewalls may filter or block access to certain categories of Web sites or multimedia. Learners often don't have administrator privileges on their PC, which is required for installation of applications, browser plug-ins, and LMS or ADL-related client software. All of these things burden an enterprise's ability to build out and maintain an effective, affordable, maintainable ADL infrastructure. One detractor from conducting ADL on a work PC is the work environment itself. Unlike an in-residence learning situation, the ADL designer has no method of ensuring interruptions and distractions are kept to a minimum, or that a block of learning is conducted during a specific time frame. However, because PCs are more common at work, generally with a faster network connection, AFIADL targets the learner's work PC as the main workhorse for ADL.

Learner's Home PC

One of the main goals of ADL is "anywhere, anytime" delivery of instructional material and learning. Unfortunately, this adds another layer of complexity to an already complicated ADL environment. The single most limiting factor of learner access from home is network bandwidth, followed closely by network security. Home-based learners may sometimes rejoice because they don't have to go through the organization's firewall, so they can get to more content—content, that is, that is not located on servers restricted to military domains (.mil, .gov, for example). Military network and system administrators often assume that home-based users are connecting via remote access server (RAS) accounts. Technically, this authenticates them as a ".mil" user with all the associated access permissions to military sites and servers. Additionally, learners using their home PCs are often hampered by less processing power and significantly reduced bandwidth caused by the use of a modem.

While much of the world is enjoying downloads at blazing fast cable or satellite speeds, a good percentage of Air Force learners are located in areas where they are forced to access the "Information Superhighway" at circa 1994 modem speed limits (28 kilobits per second, or Kbps). While these users must be taken into account, it would be detrimental if all ADL were aimed at the lowest common denominator. As a result, AFIADL targets at least the home user with 50 Kbps connection speed. This generally equates to an ADL "payload" for learning content at a bandwidth of about 40-45 Kbps. From a multimedia perspective, this is

barely sufficient to support acceptable quality audio and simple "talking head" video at low frame rates.

Shared PCs

Because everyone doesn't have a PC available to them at work and at home, most enterprises support some level of learning resource center or centralized location for ADL. The Air Force is no different in this respect. However, there are some roadblocks that shared PCs at these centers create. From a security perspective, the learner doesn't have as much control over their learning environment as they would on their own PC. Cookies or other cached files could be left on the system for other people to read or use, or the learner may forget to log off the system after conducting an ADL session. This could expose their student records, as well as making other material on the LMS or ADL system available to unauthorized users. Additionally, most shared PCs offer limited access to certain types of applications, such as email and newsgroup readers. This can be a problem if the ADL program requires the learner to have access to such a capability. The learner also may not be able to install certain programs on the PC, or configure the browser to support certain software components of the ADL course they're trying to complete.

Recommendations

ADL programs would benefit greatly from bypassing network bottlenecks, whenever and wherever possible. This can be done by distributing content across multiple servers so that no single, individual network "pipe" is overloaded or overburdened to the point it impacts efficient delivery or access. If possible, non-sensitive Web-based content should be hosted or outsourced to an appropriate application service provider or ASP. For the time being, AFIADL is keeping Privacy Act information and student data secured behind the firewall, until such time as virtual private networking (VPN) and DoD PKI solutions are in place to enable ASP hosting of LMS and other ADL functions.

High bandwidth content, such as audio, video, animations, and simulations, should be pushed to the "edge," as close as possible to the learner. AFIADL is pursuing numerous base-level server solutions for this type of learning content. One especially promising solution is to leverage the existing Air Technology Network (ATN) for datacasting and satellite broadcast delivery of high bandwidth ADL material. This would significantly reduce the impact of ADL on the Air Force's wide area network connections, which are already strained with operational traffic.

SCORM

The Sharable Content Object Reference Model, or SCORM standard, has rapidly evolved from version 1.0 to 1.2, and is eagerly being pursued by vendors and content creators alike. Effective discoverability and reuse of costly ADL online content makes many organizations align with this industry wide effort. While AFIADL has many SCORM projects in place, and fully supports evolution and implementation of the standard across the Air Force and DoD, we are aware that it is, in fact, an evolving standard. While it promotes reuse, it does not guarantee a 100% “plug and play” capability of ADL content across multiple LMS domains, boundaries, or environments. As mentioned previously, development of Web browser-based applications creates many challenges for the ADL designer and programmer. What works in one environment does not necessarily work in another, without some rework and massaging of the learning content. This can add to the development and course conversion costs, but is well worth the effort if sharable ADL content is to become a reality.

Some of the key problem areas, such as including navigation features and course-level menus within ADL content, are quickly being discovered by designers and developers. Designers are quickly learning the dangers of including server-side logic (for example, Cold Fusion, FrontPage Server Extensions, Java Server Pages, Active Server Pages) in ADL content, due to the fact that it severely limits the reuse of material except in a few specific environments that have a similar server configuration. Designers are statically embedding Web-based documents, where possible, into ADL content, so that test items aren’t impacted by links to dynamic content that changes without the course manager or subject matter expert’s knowledge. AFIADL frequently stresses the need to develop for *both* industry standard Web browser interfaces—courses and learning object that target a single browser will be problematic if they are wrapped into a course. This would require the learner to install both browsers on their PC and switch browsers in the middle of the course, possibly only for one learning objective. Some learners don’t have sufficient disk space, aren’t familiar with both browser interfaces. Some learners using work PCs aren’t even allowed to install both browsers because of security constraints.

Additional problem areas, such as the need to use proprietary LMS features and functions, examination and testing features or glossary and reference sections for example, are coming to light and will be addressed in future SCORM versions, as necessary. Early

adopters of the standard are sharing their experiences of importing and exporting database-driven content, and the need to develop content that can be shared with others at the file system level, or without the need for a backend database. To support initial implementation of a SCORM-based infrastructure within the Air Force, AFIADL acquired a SCORM-conformant LMS and content repository to further ADL pilots and prototypes. We also created a technology lab to support testing of service-specific content and learning management systems for SCORM conformance, once the test suite becomes available.

LEGACY CONTENT

Previous discussions in this paper revolved around the ability of an LMS and an ADL system to support integration of existing courseware created with legacy authoring tools. There are numerous technologies, such as Shockwave, that somewhat automate the conversion and repurposing of such legacy courseware to Web-based and ADL formats. Much of this will occur at no additional cost as part of the routine “refresh” schedule for such computer-based courses and programs. The remaining courses must be analyzed and prioritized for conversion and online delivery. Naturally, based on a cost benefit analysis, the courses with the maximum potential (highest student throughput) and ADL suitability (based on media analysis) probably will be converted first.

However, CBTs and CDs are not the only type of legacy content the Air Force has to accommodate. There is a very large amount of Air Force education and training that is conducted through in-residence schoolhouse training and paper-based correspondence courses.

In-Residence Courses

While all of an in-residence course can seldom be converted for ADL delivery, there are some suitable options that the Air Force is pursuing to reduce the overall high travel costs associated with such instruction. Primarily, this includes segmentation of in-residence courses into modules that can then be classified into appropriate learning categories. The knowledge-level information is often converted to ADL formats. In this scenario, the students complete much of this learning content before attending in-residence. The remainder is provided as online technology insertion in the classroom as necessary to support the application-level activities that are required. In such cases, ADL supports in-residence instruction, rather than attempting to replace it. ADL is obviously not a

silver bullet that fits all training and education scenarios.

Paper-Based “Correspondence” Courses

The written word has traditionally been the easiest form of providing instructional material for distance learning, and that truth continues to hold true in this age of ADL. Information technology supports efficient digitization of such paper-based instructional material, which sometimes includes graphics and tables also, and promotes what appears to be a quick and easy means of distributing it to learners electronically. However, there are several reasons to resist such a temptation.

While electronic storage and distribution is frequently touted as virtually free, we often overlook the fact that, as many studies have indicated, we as human beings tend to prefer printing large documents for offline reading, rather than reading on a computer screen. This is especially true for instructional material, which is often much more complex than online material read for entertainment or basic information. For large quantities of online instructional material, local printing can be orders of magnitude more expensive than the cost of centralized bulk printing and mass mailing. Additionally, numerous studies and a wide body of empirical evidence indicate, arguably of course, that people may not learn as effectively or retain information for as long a period from online reading.

As a result of these pressing instructional and cost effectiveness issues, AFIADL sees paper as a viable medium for distance learning in the near-term. This is especially true for the 450 or so legacy career development courses and specialty courses, which are primarily text-based with limited graphics. Converting these mandatory courses to mere “page turners,” without the necessary level of proper planning, could be detrimental to Air Force on-the-job training as well as promotion opportunities. Studies need to be conducted to evaluate the impact of ADL delivery of this material. Additionally, a considerable amount of resources must be programmed and allocated for media analysis, course conversion, small-scale pilot and prototype projects, tool acquisition, staff training, and other ADL-related studies of paper-based courses. Once again, ADL, however compelling, is not a silver bullet or a “one size fits all” solution.

WHAT'S NEXT?

AFIADL by necessity will push to go beyond where SCORM and ADL industry efforts leave off. For example, we have to pursue, where feasible, an effective online testing environment to incrementally

supplement or partially replace our costly, proctored testing system. While ADL and SCORM promote a worthy online learning experience, military learners are not always capable of being online, especially when deployed—we will have to solve the issue of offline computer-managed instruction (CMI) and integration of such a model with an online LMS for student tracking and course completion data.

Likewise, we have a good portion of our learner base located on classified networks, but who would benefit from access to unclassified training material—sharing data across these two domains can be challenging, and the security requirements of an LMS or ADL system in such an environment are daunting. The Air Force system of choice is the Air Force Portal and its underlying Global Combat Support System (GCSS) architecture—we will continue working with the Air Force education and training community to centralize ADL systems and services under this “system of systems” umbrella.

SUMMARY

Understandably, AFIADL is enthusiastic about the potential for ADL, both near-term and long-term. We aggressively support the evolving ADL standards and subscribe to a “right way, anytime, anyplace” learning model. We have to leverage our limited resources wisely to gain the maximum benefit for the Air Force, DoD, and the taxpayer. In addition to listening to the lessons learned by others, we will continue to share our expertise and lessons learned with others in the ADL community. Being an ADL “center of excellence” for the Air Force will continue to be the best and most effective method of promoting ADL and its benefits, while helping create solutions to the many challenges and potential problems. By working with partners and collaborators on our LMS and SCORM laboratory, we can greatly reduce the barriers to entry for AF customers wishing to move toward an ADL environment.